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## Relations of Social Maturity, Executive Function, and Self-Efficacy Among Deaf University Students

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### Abstract

This study explored possible associations of social maturity, executive function (EF), self-efficacy, and communication variables among deaf university students, both cochlear implant (CI) users and nonusers. Previous studies have demonstrated differences between deaf and hearing children and young adults in EF and EF-related social and cognitive functioning. EF differences also have been demonstrated between hearing children and deaf children who use CIs. Long-term influences of cochlear implantation in the social domain largely have not been explored, but were examined in the present study in terms of social maturity, as it might be related to EF and communication variables. Replicating and extending recent findings, social maturity was found to be related to somewhat different aspects of EF in CI users, deaf nonusers, and hearing students, but unrelated to hearing status, CI use, or deaf students' use of sign language versus spoken language. Self-efficacy proved a predictor of self-reported socially mature and immature behaviours for all groups. Individuals' beliefs about their parents' views of such behaviours was a potent predictor of behaviours for deaf CI users and those deaf students who reported sign language as their best form of communication.

### Keywords

Hearing loss; Self-efficacy; Social maturity; Cochlear implants; Social-emotional functioning

### Introduction

This paper examines several factors involved in the behaviours of deaf youth related to social maturity/immaturity, that is, the extent of socially appropriate and adaptive social functioning. Consideration of the ways in which children acquire the social and cognitive skills associated with social maturity currently tend to centre on theory of mind (e.g., Hughes & Leekam, 2004; for reviews, see Peterson, 2009; Wellman, 2011). In the case of

deaf children and adolescents, however, several other factors have been of particular interest to researchers and practitioners. Perhaps foremost is language, insofar as many deaf youth exhibit delays relative to their hearing peers in their language abilities, regardless of whether they are using spoken or sign language. Delays in expressive language can limit the extent and diversity of their social interactions (e.g., Most, Ingber, & Heled-Ariam, 2012), while delays in receptive language can limit the incidental learning underlying much of social functioning (Kusché & Greenberg, 1983; Morgan, 2015). Executive function (EF) and perceived self-efficacy also are at issue with regard to the social maturity of deaf children and youth, insofar as levels of functioning in those domains influence several aspects of cognitive, social, and academic performance (Cheng, Zhang, & Hu, 2016; Hauser, Lukomski, & Hillman, 2008; Kronenberger Pisoni, Henning, & Colson, 2013; Lent, Brown, & Larkin, 1984).

### Executive Function and Deaf Learners

*Executive function* (EF) refers to a group of cognitive abilities that support or control an individual's behaviour across cognitive (including academic), social, and other domains. *Self-efficacy* also affects behaviour in those domains insofar as the individual's belief in the ability to succeed in any given situation will influence how the situation is approached and the resources brought to bear on dealing with that situation. EF and self-efficacy, together with language abilities, also will interact with the ways in which deaf children and youth behave and are treated by others at home and at school. This can create additional variability in the acquisition of age-appropriate social-emotional and cognitive skills (Hauser et al., 2008). For example, deaf children who have the benefits of more effective linguistic interactions with peers, parents, and other significant adults likely would have a better understanding of social responsibility and expectations. Consistent with that suggestion, Cates and Shontz (1990) found that role-taking ability was positively related to social adjustment, self-image, and communication effectiveness among deaf 7- to 14-year-olds. However, the children's role-taking abilities were not related to measures of their actual social behaviour.

Possible relations between social behaviour and communication variables among older deaf learners were examined more recently by Marschark et al. (2017). That study investigated the appropriateness of social behaviour in terms of reports from deaf secondary school and university students of the frequency with which they engaged in positive and negative behaviours reflecting social maturity and immaturity. Of particular interest was the extent to which social maturity might be related to EF and use of CIs, given previous studies indicating children with CIs to experience challenges in the domains of both EF and social functioning (e.g., Edwards, Khan, Broxholme, & Langdon, 2006; Kronenberger, Colson, Henning, & Pisoni, 2014; Kronenberger, Pisoni, Henning, & Colson, 2013). Marschark et al. (2017) found social maturity and EF significantly related among the deaf secondary school students, as those who reported fewer EF difficulties engaged in more behaviours reflecting social maturity; those who reported more EF difficulties engaged in more behaviours reflecting social immaturity. CI users did not differ from peers who did not use CIs ("nonusers") in either of those domains, but deaf secondary school students who relied primarily on sign language reported more immature behaviours than deaf peers who relied

primarily on spoken language. There were no significant group differences in social maturity among university-age CI users, deaf nonusers, and hearing students.

Unlike the deaf secondary school students, social maturity was not related to language modality among deaf university students in the Marschark et al. (2017) study, but social maturity was related to EF for all groups. Both CI users and deaf nonusers reported significantly greater EF difficulties than hearing peers in several domains, but there were no significant EF differences between the two deaf groups. Kronenberger et al. (2014) found greater EF difficulties among deaf children and youth (aged 7 to 27 years) who used CIs relative to hearing peers. In that and several other studies obtaining such findings (e.g., Kronenberger et al., 2013), however, Kronenberger and colleagues did not include deaf individuals who do not use CIs.

Extending the existing literature on social maturity and EF among deaf individuals, including Marschark et al. (2017), the study described below addressed three issues in need of further examination. One issue concerns possible differences in social maturity between deaf and hearing learners beyond childhood. Older literature addressing social-emotional functioning among deaf children reported them to be less socially mature than hearing age-mates (Greenberg & Kusché, 1989; Schlesinger & Meadow, 1972); more recent literature has found younger deaf students to have difficulties across several social-behavioural domains (Hintermair, 2013; Peterson, 2009; Punch & Hyde, 2011). However, there is only limited evidence available concerning social-emotional functioning among older deaf learners. Marschark et al. (2017) did not include a comparison group of hearing secondary school students, and the observed lack of social maturity differences among deaf and hearing university students therefore, could simply reflect increasing social maturity with age. Differences between deaf and hearing youth in perceived self-efficacy—the belief in one’s capability to plan and perform actions to attain a certain outcome (Bandura, 1997)—also might help to explain the lack of social maturity differences observed among the deaf and hearing university students (Cheng et al., 2016; Lent et al., 1984). Alternatively, the materials used in the Marschark et al. study may have been inappropriate for university-age students. The positive and negative behaviours in their self-report instrument were drawn from Duckworth, Gendler, and Gross’s (2014, Table 1, p. 201) study involving hearing middle school students. Although perhaps appropriate for deaf secondary school students, the frequencies with which deaf and hearing university students litter or clean their rooms might not be sufficient to distinguish differences in social maturity/immaturity. The present study therefore examined an additional set of social behaviours drawn from an instrument designed for university-age individuals.

### **Social-Emotional Functioning and Cochlear Implant Use**

A second issue in need of further examination derives from several studies that have reported social-emotional advantages to deaf children after cochlear implantation, at least among those with better spoken language skills (e.g., Bat-Chava & Deignan, 2001; Jambor & Elliot, 2005; Wheeler, Archbold, Gregory & Skipp, 2007). Marschark et al. (2017), however, did not find social maturity differences between CI users and deaf nonusers, and other studies have found that by secondary school age, early advantages among CI users relative to deaf

nonusers in vocabulary, reading, and other academic domains are attenuated or absent (Convertino, Borgna, Marschark, & Durkin, 2014; Crowe, Marschark, Dammeyer, & Lehane, 2017; Geers, Tobey, Moog, & Brenner, 2008; Marschark, Shaver, Nagle, & Newman, 2015). Long-term influences of cochlear implantation on social behaviour have not been explored, and it may be that early advantages in that domain are later attenuated, just as they are in language and academic domains.

A third issue addressed by the present study was the distinguishing of possible effects on social maturity related to CI use compared to primary reliance on spoken language. Although the Marschark et al. (2017) study did not find differences in social maturity between deaf CI users and deaf nonusers, such differences were observed between secondary school students who used sign language and those who used spoken language. Parents of children with disabilities sometimes hold them to less stringent rules and responsibilities compared to their typically-developing age-mates (Doren, Gau, & Lindstrom, 2012), a factor directly related to social maturity. Although relevant research apparently has not yet been conducted with deaf children in hearing families, such deferrals of social expectations might be more likely when deaf children of hearing parents rely on sign language rather than spoken language, making parent-child communication less effective (Greenberg & Kusché, 1989; Kusché & Greenberg, 1983). Deaf children may be able to infer family and social values by observing the consequences of their own and others' nonverbal behaviour. However, this process is far slower and less efficient than direct parent-child communication aided by incidental learning via language.

Interestingly, although less rigorous social expectations for (especially hearing) parents of deaf children are frequently mentioned in discussions among stakeholders in deaf education, there does not appear to be literature specifically addressing it. Nevertheless, it seems likely that better parent-child communication as well as better communication with peers and adults outside the home would have the effect of more effectively instilling in deaf children family and community values and expectations. This advantage should be reflected in greater social maturity and less frequent engagement in the kinds of negative behaviours addressed in the Marschark et al. (2017) study. Working against that interpretation, however, was the fact that a similar effect of language modality was not observed among the university students. But there well may have been language fluency differences between the diverse secondary school sample in that study and the presumably more restricted sample that had gained university entry.

### The Present Study

The present study was designed to examine relations of social maturity, EF, self-efficacy, CI use, and students' self-reported best mode of communication among deaf university students. As will be described further below, it included a subset of the positive and negative behaviours addressed in the Marschark et al. (2017) study, but also included items more appropriate to a university population. This allowed evaluation of the possibility that the behaviours queried in the Marschark et al. study were inappropriate for use with older, university-age students. These materials also provided the opportunity to re-examine possible differences in socially mature and immature behaviours between deaf university

students who used CIs or not and those who primarily used sign language or spoken language.

This study used the same instrument as Marschark et al. (2017) for evaluating cognitive and academic aspects of EF, the *Learning, Executive, and Attention Functioning* (LEAF) scale (Kronenberger, Beer, et al., 2014; Castellanos, Kronenberger & Pisoni, 2016). Based on earlier findings with both children and young adults, (1) hearing students were expected to report fewer EF difficulties than deaf students, but (2) no significant differences were expected between CI users and deaf nonusers.

A measure of self-efficacy, the *Generalized Self-Efficacy* (GSE) scale (Schwarzer & Jerusalem, 1995), also was administered in this study. Self-efficacy has demonstrated links to positive academic functioning among hearing university students (Lent et al., 1984) and positive cognitive functioning among deaf learners (Cheng et al., 2016). However, it has not been studied with regard to social or emotional functioning among deaf learners, and thus we were unable to make evidence-based predictions in this study.

Finally, the present study investigated the possibility that parents of deaf learners might hold them to different standards with regard to socially mature behaviours, or at least that deaf learners perceive them as doing so (see Meadow, 1968/2005). Participants provided their perceptions of how their parents and their high school principals would view the students' participation in the positive and negative behaviours. It was expected that principals would be seen as viewing positive behaviours more positively and negative behaviours more negatively than parents. Among CI users, enhanced parent-child communication through spoken language was expected to tie reported frequencies of socially mature and immature behaviours to ratings of their parents' views more closely than would be the case among deaf nonusers. The extent to which participants' beliefs about parents' and principals' views are related to their self-reports of actually engaging in the behaviours was intended to provide an indicator of the kinds of influences that affect the development of social maturity among deaf and hearing learners. Together, these manipulations were designed to provide a clearer picture of foundations of social maturity in deaf university students who vary in CI use, their sign language and spoken language skills, and their primary language modality.

## Method

### Participants.

Participants were 115 deaf<sup>1</sup> and 80 hearing university students enrolled at Rochester Institute of Technology (RIT). RIT includes the National Technical Institute for the Deaf (NTID) as one of its nine colleges, but deaf participants were drawn from across the university. All participants were volunteers recruited through posted advertisements or personal contact and paid for their time. Forty-nine of the deaf students were active CI users (mean age of implantation = 6.39 years,  $SD = 4.76$ ). Sixty-seven of the deaf participants, including 16 CI users, reported using hearing aids; the remaining 15 indicated not using

<sup>1</sup>Participants referred to as "deaf" varied in their hearing losses, but all were sufficient to qualify for related support services (i.e., sign language interpreting or real-time text) as determined on an individual basis by university personnel. Current hearing thresholds were not available for the purposes of this study.

personal assisted listening devices. Deaf participants varied in their self-reported sign language and spoken language abilities and their ages of sign language acquisition, all variables to be considered later (see Table 1).

### Materials and Procedure.

Self-reports of socially mature and immature activity were obtained using a questionnaire created for the purposes of this study containing 20 positive and 20 negative behaviours reflecting appropriate and inappropriate socially-oriented behaviours, respectively (see Appendix). Half of the behaviours were drawn from those Duckworth et al. (2014) and used by Marschark et al. (2017) with secondary school and university students. The other half of the positive and negative behaviours were based on items from the American College Health Association's National College Health Assessment (NCHA). Items from both Duckworth et al. (2014) and the NCHA were selected only on the basis of their (1) reflecting social maturity/immaturity, (2) being behaviours likely among university students, and (3) being unambiguous without further clarification. Participants were asked how often they engaged in the 20 mature and 20 immature behaviours. The positive and negative items were randomly intermixed and presented with the instruction "Please read carefully and circle how often you do the following." Each item was accompanied by a 6-point Likert scale from "never" to "always." The behaviour questionnaire is provided in the Appendix.

Participants' judgements of how their parents and high school principals would view the participants engaging in the behaviours were obtained by presenting all of the behaviours two additional times (see Appendix). One administration asked them to "Please read carefully and circle a number to show how your parents would feel about you doing this behaviour," with each item accompanied by a 6-point Likert scale from "extremely bad" to "extremely good." The same rating scale accompanied another administration that asked participants to "Please read carefully and circle a number to show how your high school principal would feel about you doing this behaviour."

EF was assessed using the LEAF, a questionnaire-based measure containing 55 questions about recent experiences or behaviours characterizing EF and closely-related cognitive and academic abilities in 11 areas: Comprehension and Conceptual Learning (understanding and tracking new information in spoken or written form), Factual Memory (memory for facts and details), Attention (attention, focus), Processing Speed (speed of starting and completing work under conditions requiring concentration); Visual-Spatial Organisation (organisation and visual-spatial skills), Sustained Sequential Processing (planning, following, and completing sustained tasks), Working Memory (focusing, remembering, and tracking when required to simultaneously remember something and engage in another activity), Novel Problem-Solving (independent learning or problem-solving in new or unfamiliar situations), Mathematics Skills (maths and calculation), Basic Reading Skills (reading, phonics, and word recognition), and Written Expression Skills (written expression, expressive writing).<sup>2</sup> The original LEAF was a parent-report measure; the present study used a more language accessible self-report version of the instrument designed and validated for deaf secondary

<sup>2</sup>The first eight LEAF subscales pertain to cognitive dimensions of EF. The last three tap academic dimensions of EF and were not used in the Marschark et al. (2017) study.



school and university students by Marschark et al. (2017) and demonstrated to be at a 5<sup>th</sup> grade reading level. Following the standardised procedure, each LEAF item was rated on a 4-point Likert scale from “never” to “very often.”

Self-efficacy was evaluated using the General Self-Efficacy Scale (GSE) (Schwarzer & Jerusalem, 1995), a well-documented, 10-item questionnaire that assesses perceived self-efficacy in coping and adaptation in everyday life. The GSE has been used extensively with school-aged children as well as adults, and no language revision was needed.

A communication questionnaire was completed by deaf participants only. That instrument was an abbreviated version of a questionnaire administered to incoming deaf students at RIT for the purposes of classroom service provision (i.e., interpreting, notetaking, real-time text) and in research. RIT has utilised this self-report measure instead of face-to-face communication interviews for over 30 years because it is faster, can be administered online, and has been shown to be both valid and reliable (Marschark et al., 2018; McKee, Stinson, & Blake, 1984; Spencer et al., 2018). Following the Language Communication Background Questionnaire, the questionnaire asked participants for the ages at which they learned to sign and had them rate their overall sign language skill on a 5-point Likert scale from “I don’t know sign language” to “excellent.” They also rated how well they understand spoken language on a 5-point scale from “nothing” to “everything people say” and how much they thought others understood their speech on a 5-point scale from “nothing” to “everything I say.” The latter two ratings were averaged to yield an overall measure of spoken language skill comparable to the LCBQ overall rating of sign language skill. The use of Likert scales in self-ratings of language skills run the risk of individuals inflating their assessments (and perhaps avoiding the end points). However, they have proven consistent with objective assessments of sign language and spoken language abilities among deaf university students with and without CIs in previous studies (e.g., Marschark et al., 2018; Spencer et al., 2018) as well as behavioural outcomes in a variety of studies conducted with that population (e.g., Convertino et al., 2009). Further, for the purposes of statistical analyses reported below, only relative differences in self-reported language skills are relevant here, and thus possible discrepancies with objective assessments are not at issue. Finally, the deaf participants also were asked to indicate whether they used hearing aids or CIs and, if the latter, the age(s) at which they had received them; they also were asked which language modality was their “best form of communication” (signed or spoken)<sup>3</sup>. Use of sign language and/or spoken language were not required for the purposes of this study. The question was asked so that use of spoken language could be distinguished from CI use (see below), rather than assuming that all CI users depend primarily on spoken language.

All of the materials were completed by participants online and untimed. Order of administration was self-reported behaviour, LEAF, judgements of parents’ views of behaviour, GSE, judgements of principals’ views of behaviour, and Communication Questionnaire.

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<sup>3</sup>Many if not most deaf students in the population sampled use both spoken language and sign language to some extent. Because the two modes of communication are not mutually exclusive, participants were asked to identify their “best” form of communication while also separately rating their sign language and spoken language skills. Eleven deaf students refused or neglected to identify their best form of communication.

## Results and Discussion

A preliminary analysis of variance (ANOVA) was performed in order to determine whether the secondary school-level behaviour items and the university-level behaviour items yielded different results. Participant group (deaf nonusers, CI users, hearing) was a between-subjects variable, and behaviour level (secondary school, university) and valence (positive [socially mature], negative [socially immature] behaviours) were within-subjects variables. That analysis yielded main effects of behaviour level,  $F(1, 138) = 409.62, p < .001$ , as both positive and negative secondary school behaviours were rated as occurring more frequently than university-level behaviours, and behaviour valence,  $F(1, 192) = 1724.90, p < .001$ , as positive behaviours were reported to occur more frequently than negative behaviours. There also was a significant main effect of participant group,  $F(2, 138) = 3.16, p < .05$ , and a significant group by behaviour level by valence interaction,  $F(2, 138) = 3.30, p < .05$ .

Reporting of more socially mature behaviours than socially immature behaviours is not unexpected. Reporting of more socially mature and socially immature secondary school-level than university-level behaviours by the university-age participants, however, might seem surprising. Examination of the relevant items in the Appendix, however, shows that the more “adult-like,” university-level behaviours are likely to occur with lower frequency (e.g., volunteering in the community versus paying attention in class; stalking versus littering). Given the lack of any obvious pattern for the interaction, the basis of the interaction was explored further with univariate ANOVAs for positive and negative behaviours at the two levels. These yielded significant effects of group only for the positive secondary school level behaviours,  $F(2, 138) = 4.00, p < .05$ , and positive university level behaviours,  $F(2, 138) = 4.00, p < .05$ . Bonferroni-adjusted post hoc tests indicated significantly higher positive behaviour scores for the CI users than the deaf nonusers at the secondary school level and significantly higher positive behaviour scores for the CI users than the hearing participants at the university level. Neither analysis of negative behaviours yielded a significant effect of group. The three-way interaction notwithstanding, these results indicate that the lack of significant differences between deaf and hearing university students in the Marschark et al. (2017) study was not the result of their materials being inappropriate for university-level students. Behaviour level therefore will not be considered further.

### Social Maturity, Self-Efficacy, Executive Function, and Communication

In order to examine possible differences among the three participant groups in the frequencies with which they reported engaging in socially mature and socially immature behaviours, their positive and negative behaviour scores were examined using a 3 (group: CI users, deaf nonusers, hearing) by 2 (behaviour valence: positive, negative) ANOVA (see Table 2).<sup>4</sup> That analysis yielded a main effect of valence,  $F(1, 138) = 1724.90, p < .001$ , as socially mature behaviours were reported as occurring more frequently than socially immature behaviours, and a main effect of group,  $F(2, 138) = 3.16, p < .05$ . The latter effect reflects the higher positive behaviour scores of the CI users compared to the other two

<sup>4</sup>Although the comparison of interest was between CI users and nonusers, results of deaf students who used hearing aid with those who did not were compared using independent-sample *t*-tests. Neither behaviour scores nor LEAF scores yielded any significant differences between those two groups, all  $t$ s (113) 1.54, and that variable will not be considered further.



groups, but Bonferroni-adjusted post hoc tests indicated none of the paired comparisons to be significant (Table 2). Because 22 of the 49 CI users indicated that sign language was the best form of communication, while previous studies indicated that social-emotional benefits of children's CI use were largely limited to those with better spoken language abilities, independent *t*-tests compared the frequencies of positive and negative behaviours reported by deaf participants who indicated that sign language or spoken language was the best form of communication. Neither comparison was significant, positive behaviours (69.98 vs. 72.73):  $t(102) = 1.23$ , negative behaviours (15.57 vs. 15.92):  $t(102) = 15.92$ .

Comparison of participants' beliefs about their parents' and high school principals' views of their engaging in various behaviours involved a 3 (group: deaf nonusers, CI users, hearing) by 2 (perspective: parents', principals') by 2 (behaviour valence: positive, negative) ANOVA in which the latter two variables were within-subjects. That analysis yielded a main effect of valence,  $F(1, 138) = 1851.11$ ,  $p < .001$ , as socially mature behaviours were reported as occurring more frequently than socially immature behaviours (Table 2). There was also a significant perspective by valence interaction,  $F(1, 138) = 7.68$ ,  $p < .01$ . The interaction reflected the finding that, as predicted, students rated principals' views of socially mature behaviours more positively and rated principals' views of socially immature behaviours more negatively as compared to their parents' views. A significant group by perspective interaction,  $F(2, 138) = 7.68$ ,  $p < .01$ , reflected the fact that while the CI users indicated little difference between parents' and principals' perspectives, overall ratings by the deaf nonusers were slightly higher for principals than parents, and the reverse was true for the hearing participants (see Table 2). Independent sample *t*-tests comparing ratings of parents' and principals' perspectives for those deaf students indicating sign language versus spoken language as their best form of communication indicated that those who use spoken language rated their principals' use of positive behaviours more positive,  $t(102) = 2.11$ ,  $p < .05$ , and negative behaviours more negative,  $t(102) = 2.11$ ,  $p < .05$ , compared to those of students who used sign language. Possible associations between ratings of parents' and principals' perspectives and student behaviours are considered in the next section.

Participants' GSE scores, the summed ratings across the 10 questions regarding their perceived self-efficacy (Schwarzer & Jerusalem, 1995), were analysed using a univariate ANOVA in which group (deaf nonusers, CI users, hearing) was the between-subjects variable. That analysis yielded a significant main effect,  $F(2, 138) = 3.31$ ,  $p < .05$ . As can be seen in Table 3, perceived self-efficacy increased from CI users to the deaf nonusers to the hearing participants; Bonferroni-adjusted post hoc tests indicated that only the difference between the hearing participants and the CI users was significant.

Possible associations between EF and social maturity were of primary interest here, but possible EF differences among the three groups of participants were considered first. Because various aspects of EF are interdependent (Castellanos et al., 2016), the 11 LEAF subscales typically are intercorrelated. In the current data set, 80% of the intercorrelations among the subscales were statistically significant; in the Marschark et al. (2017) study, 89% of intercorrelations using the same, language-accessible version of the LEAF were significant, as were 93% of intercorrelations using the original self-report LEAF. Analysis of EF scores therefore initially involved a MANOVA in which the 11 LEAF subscales were

dependent variables, and group (deaf nonusers, CI users, hearing) was a between-subjects variable. That analysis yielded a main effect of group,  $F(22, 256) = 2.34, p = .001$ . Univariate tests revealed a significant effect only for Written Expression,  $F(2, 138) = 5.13, p < .01$ . Bonferroni-adjusted post hoc tests indicated that only the difference between the hearing participants and the CI users was significant, the CI users reporting more difficulties in expressive writing.

The lack of significant differences between deaf and hearing university students on any of the eight cognitive LEAF subscales (see Note 2) contrasted with predictions based on Hauser et al. (2008), Marschark, Spencer et al. (2015), and Marschark et al. (2017). Extensive experience by the developer of the LEAF, however, has indicated that such null effects occur occasionally on self-report EF measures because some learners are unaware of (or minimise in self-report) their EF difficulties, resulting in underreporting. Moreover, previous use of the LEAF with university students primarily has involved first-year students who might be particularly aware of their EF difficulties because they find so many new challenges with regard to EF in the university setting. This study did not offer a way to evaluate the first possibility, but the second suggestion was evaluated by repeating the MANOVA including only first-year students (23 CI users, 30 deaf nonusers, 41 hearing students). In addition to the significant main effect of group,  $F(22, 162) = 2.01, p < .01$ , univariate tests revealed significant effects for Written Expression,  $F(2, 91) = 4.83, p = .01$ , and Attention,  $F(2, 91) = 3.45, p = .05$ . Bonferroni-adjusted post hoc tests indicated a significant difference between the hearing participants and the CI users for Written Expression as the CI users reporting more EF-related difficulties in writing, and between the hearing participants and the deaf nonusers for Attention, with the deaf nonusers reporting more EF-related difficulties in paying attention and focusing in various situations. It is unclear whether such results suggest that first-year university students might have greater EF difficulties than more senior students or just think they do. Alternatively, individuals with greater EF difficulties may be less likely to attend university or more likely to drop out if they do. In any case, further research is warranted.

### Predicting Socially Mature and Socially Immature Behaviours

The lack of overall significant differences in social maturity between deaf and hearing university students, between those who primarily used sign language or spoken language, or between CI users and deaf nonusers replicated findings of Marschark et al. (2017). The last of these findings also is consistent with the lack of academically-related differences between CI users and deaf nonusers at the university level (e.g., Convertino et al., 2014; Crowe et al., 2017). It remains possible, however, that there may be different foundations of social maturity between deaf CI users and deaf nonusers and between deaf and hearing individuals more broadly. These possibilities first were examined via stepwise multiple regressions, separately for CI users, deaf nonusers, and hearing students, alternately using the frequency of reported socially mature and socially immature behaviour scores as criterion variables. LEAF scores, GSE scores, parents' and principals' rated behaviour perspectives, and the several communication variables listed in Table 1 served as predictor variables. All and only those predictor variables accounting for significant proportions of the variance are reported

below, in decreasing order of their contributions ( $R^2$  change) to the final regression equations. (Note that higher LEAF scores indicate greater EF difficulties.)

Reports of more frequent socially mature behaviours among the deaf CI users were predicted by how positively they thought their parents viewed the behaviours,  $R^2 = .37$ ,  $\beta = 0.47$ , and their greater perceived self-efficacy,  $R^2 = .06$ ,  $\beta = 0.34$ . The frequency of those behaviours also were predicted by participants' having fewer reported difficulties in mathematics,  $R^2 = .06$ ,  $\beta = -0.26$ , more difficulties in basic reading skills,  $R^2 = .05$ ,  $\beta = 0.35$ , and fewer difficulties in comprehension and conceptual learning,  $R^2 = .04$ ,  $\beta = -0.26$ . Socially immature behaviours were less frequent with parents' more negative views of the behaviours,  $R^2 = .21$ ,  $\beta = 0.48$ , and more reported EF difficulties associated with visual-spatial organisation,  $R^2 = .11$ ,  $\beta = 0.33$ .

The only significant predictor of reported socially mature behaviours among deaf nonusers was their perceived self-efficacy,  $R^2 = .27$ ,  $\beta = 0.52$ , as greater self-efficacy predicted more mature behaviours. The frequency of their reported socially immature behaviours was predicted only by their more frequent EF difficulties associated with sustained sequential processing,  $R^2 = .09$ ,  $\beta = 0.30$ .

The frequency of reported socially mature behaviours among the hearing students was predicted by the reported frequency of EF difficulties associated with visual-spatial organisation,  $R^2 = .31$ ,  $\beta = -0.40$ , parents' more positive views of the behaviours,  $R^2 = .09$ ,  $\beta = 0.29$ , and students' greater perceived self-efficacy,  $R^2 = .06$ ,  $\beta = 0.26$ . The frequency of their reported socially immature behaviours was predicted by the reported frequencies of EF difficulties associated with attention,  $R^2 = .08$ ,  $\beta = 0.29$ .

Taken together, the results of the multiple regression analyses indicate that the frequency of socially mature behaviours reported by the university student participants was reduced and the frequency of socially immature behaviours increased in the presence of difficulties in EF. The specific aspects of EF associated with reduced socially mature and immature behaviours differed across the three groups, consistent with findings from Marschark et al. (2017). Importantly, greater perceived self-efficacy was associated with more socially mature behaviour in all groups. Neither self-reports of sign language and spoken language abilities nor students' self-reported best form of communication were significant predictors of socially mature or immature behaviours among CI users or nonusers (see below).

CI users' socially mature and immature behaviours were most strongly predicted by how they saw their parents' views on the behaviours in question. This result presumably was a consequence of enhanced parent-child communication through spoken language, made possible by the participants' CIs. In an attempt to distinguish these two possibilities, two additional stepwise multiple regression analyses were conducted, similar to those above, but in which the deaf participants were divided into two groups depending on whether they had indicated that spoken language or sign language was their best form of communication. The results indicated that for those participants who indicated sign language as their best form of communication, the frequency of their reported socially mature behaviours was predicted by their parents' views of the behaviours,  $R^2 = .47$ ,  $\beta = 0.67$ , and their self-rated spoken

language skills,  $R^2 = .11$ ,  $\beta = 0.33$ . The frequency of their reported socially immature behaviours was predicted only by reported EF difficulties associated with working memory,  $R^2 = .24$ ,  $\beta = 0.49$ . There were no significant predictors of either the frequency of socially mature or socially immature behaviours for participants who indicated that spoken language was their best form of communication.

## Conclusions, Limitations, and Future Directions

The present study examined relations among social maturity, EF, CI use, self-efficacy and communication skills among deaf university students. In addition, it examined possible sources of students' social maturity by obtaining judgements of their perceived self-efficacy and how they believed their parents and their high school principals would view their engaging in socially mature and socially immature behaviours. Results indicated that, for both deaf and hearing participants, social maturity was associated with fewer EF difficulties and greater perceived self-efficacy. Social maturity among deaf participants who were CI users as well as those CI users and nonusers who indicated that sign language was the best form of communication was strongly influenced by their parents' views on social behaviour. The fact that spoken language predicted the frequency of socially mature behaviours even among the participants who reported sign language was the best form of communication suggests that spoken language between hearing parents and their deaf children may be particularly important in this regard. The lack of any predictive power of deaf participants' sign language skills or ages of sign language acquisition is consistent with this suggestion, but further research examining *language* abilities, separate from skills in signed and spoken language modalities, clearly is needed. Such studies would be most informative if they included participant samples at different ages, more nuanced audiological measures, and objective language assessments. Of greatest utility would be longitudinal studies that examine the long-term social-emotional impact of cochlear implantation in the same way that recent studies are addressing long-term consequences with regard to academic and cognitive outcomes.

The present study replicated the findings of Marschark et al. (2017) indicating no significant differences between university students who were CI users and deaf nonusers on any of the eight LEAF cognitive subscales. The lack of any broad differences in EF between CI users and deaf nonusers at the university level suggests that any benefits of cochlear implantation to EF among young deaf children dissipate with age, as do early benefits in vocabulary, world knowledge, and academic achievement (Convertino et al., 2014; Crowe et al., 2017; Geers et al., 2008; Marschark, Spencer, et al., 2015).

Previous studies involving deaf children and adolescents have found strong relations between language and EF (Figueras, Edwards, & Langdon, 2008; Hintermair, 2013; Kronenberger, Colson et al., 2014; Marschark, Spencer et al., 2015; Remine, Care, & Brown, 2008). Neither the present study nor that of Marschark et al. (2017), however, found significant differences in EF between university students who primarily used sign language and those who primarily used spoken language. The earlier study found only marginal differences in EF between secondary school students who used signed and spoken language, favouring the latter. Presumably, by the time deaf individuals reach university age, any EF

differences related to language modality have resolved, at least for those with language abilities sufficient to gain them entrance to university. Given the small age differences between the deaf secondary school students and the deaf university students in the Marschark et al. study, however, the investigators concluded that their findings were more likely a consequence of greater diversity among the secondary school students than university students. Definitive examination of the two alternatives would require inclusion of a diverse sample of university-age participants who are not enrolled in university.

Also consistent with findings of Marschark et al. (2017), the present study found no significant differences in social maturity between deaf and hearing university students. Contrasting results obtained with children and adolescents in studies cited earlier suggests that social behaviour problems in younger deaf learners may ameliorate over time. Alternatively, it may be that individuals lacking in social maturity are less likely to apply to and/or enter university. In either case, further research needs to explore changes in cognitive and social-emotional functioning as they relate to deaf and hearing learners' language abilities and academic outcomes.

The finding of a strong positive impact of parent influence and self-efficacy on social maturity among some deaf learners also calls for further investigation. There was no indication that parents of deaf learners hold them to any lesser social rules or responsibilities than do parents of hearing learners—at least from the perspectives of deaf and hearing university students. Rather, the association between parents' views of the deaf participants' social behaviours and their socially mature behaviour suggests the possibility that related interventions in family-centred intervention programming (Sass-Lehrer, 2015) could help to reduce the well-documented behaviour problems frequent among deaf children and adolescents (e.g., Hintermair, 2013; Quittner et al., 2010). Beyond the home, such problems interfere with both classroom learning and mature social functioning, and interventions specifically targeted at appropriate school behaviour also might prove beneficial for both social-emotional functioning and academic progress. Given the different behavioural expectations from preschool through secondary school and beyond, such programming may require interventions that start early and continue throughout the school years (Greenberg et al., 2003). The extent to which such social-emotional habilitation might have a positive impact on EF more generally remains to be explored.

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## Appendix

The 40 items below were presented, randomly intermixed, three times. Each item had the appropriate rating scale accompanying it, and each set of items carried one of the three instructions below.

**Student behaviour questionnaire:**

Please read carefully and circle how often you do the following:

Never 0 1 2 3 4 5 All the time

**Judgement of parental perspective:**

Please read carefully and circle a number to show how your parents would feel about you doing this behaviour:

Extremely bad 0 1 2 3 4 5 Extremely good

**Judgement of high school principal perspective:**

Please read carefully and circle a number to show how your high school principal would feel about you doing this behaviour:

Extremely bad 0 1 2 3 4 5 Extremely good

**Behaviour items drawn from the American College Health Association's National College Health Assessment****Negative**

Get drunk

Have unprotected sex

Touch someone sexually without their okay

Stalk someone (following, calling, or waiting for someone who doesn't like it)

Call people bad names or say things to hurt their feelings

Hit or hurt someone's body

Use illegal drugs

Use someone else's prescription drugs (Rx)

Hurt yourself on purpose

Gamble (for money)

**Positive**

Have someone else drive (DD) if you drink

Wear a seatbelt in cars

Participate in school clubs or teams



Volunteer in the community

Help or talk to someone who looks sad or depressed

Exercise to stay healthy

Tell someone if they've had too much to drink

Eat healthier foods (fruits and vegetables)

Help a stranger

Be the designated driver (DD) for someone who's drinking

## **Behaviour items drawn from Marschark, Kronenberger, et al.'s (2016) Behaviour Questionnaire**

### **Negative**

Text while driving

Throw trash on the ground or out of the car window

Borrow things from someone without asking

Interrupting someone while they are talking/signing

Gossip

Socialize instead of doing school work

Not go to class

Expect other people to take care of things for me

Don't show up for appointments

Don't admit when you are wrong

### **Positive**

Pay attention in class

Keep your promises to other people

Keep your room clean

Respect a sister's, brother's, or a friend's personal space

Have patience with others

Make sure there is enough food for everyone before helping yourself

Save money for future needs

Finish homework on time

Work as hard as other people on group projects

Tell people if you will be late or miss an appointment

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**Table 1.**

Means and standard deviations of communication variables for deaf participants.

	CI Users		Deaf Nonusers	
Communication Variables				
Age of (First) Implantation (yrs.)	6.39	4.76		
Overall Speech Ability	4.29	1.29	3.73	1.68
Overall Sign Ability	3.19	0.77	3.11	0.98
Age Learned to Sign	1.65	0.92	1.76	0.96

Overall speech ability and sign ability were rated on a 5-point like grid scale.

**Table 2.**  
Means and standard deviations of social maturity/immaturity scores for deaf and hearing participants.

Behaviour Questionnaire Scores	CI Users			Deaf Nonusers		Speech Best		Sign Best		Hearing	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean
Positive Behaviours: Students' Reported Frequency	73.0	11.76	66.22	14.08	72.73	11.01	69.98	11.65	68.67	11.00	11.13
Positive Behaviours: Students' Parent Rating	82.38	11.58	76.91	19.56	78.00	20.95	70.82	18.73	86.20	11.13	11.51
Positive Behaviours: Students' Principal Rating	84.08	13.83	80.67	15.60	82.27	23.08	73.07	21.06	87.18	11.51	5.57
Negative Behaviours: Students' Reported Frequency	15.57	6.72	15.96	8.81	15.92	9.37	15.57	8.20	14.91	5.57	6.77
Negative Behaviours: Students' Parent Rating	13.45	13.45	11.51	9.68	12.13	13.03	15.02	15.35	11.44	6.77	11.11
Negative Behaviours: Students' Principal Rating	10.04	12.91	12.29	17.57	6.85	10.85	11.29	11.36	7.65	11.11	

Note: Data reported for deaf CI Users vs. Deaf Nonusers and those indicating spoken language or sign language as their best form of communication are based on the same individuals.



**Table 3.**

Means and standard deviations of executive function scores and self-efficacy for deaf and hearing participants.

	CI Users		Deaf Nonusers		Hearing	
LEAF (Executive Function) Cognitive and Academic Scores						
Comp./Conceptual Learning	3.79	2.42	4.20	2.17	3.51	2.36
Factual Memory	4.96	3.02	4.64	2.46	5.49	3.24
Attention	5.09	3.11	4.36	2.40	5.67	3.50
Processing Speed	5.68	3.31	5.91	2.92	5.63	3.03
Visual-Spatial Organisation	3.15	2.42	3.42	2.37	3.90	2.79
Sustained Sequential Processing	3.00	2.02	3.56	2.16	3.00	2.42
Working Memory	4.64	2.72	4.20	2.03	3.84	2.73
Novel Problem-Solving	2.66	2.28	3.11	2.39	3.10	2.85
Mathematics	5.60	3.65	6.18	3.65	4.78	3.75
Reading	3.89	2.86	3.60	2.56	3.33	2.92
Writing	4.72	3.28	3.47	2.72	2.86	2.68
GSE (Perceived Self-Efficacy)	30.15	4.66	31.87	5.53	32.71	4.68

Note: Higher LEAF scores indicate greater EF difficulties.